

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 6,723,656 B2
APPLICATION NO. : 09/902931
DATED : April 20, 2004
INVENTOR(S) : Kirk Martin

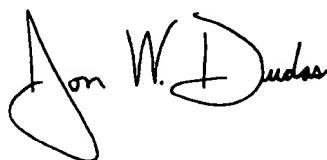
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It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

The title page should be deleted to appear as per attached title page.
The sheets of drawings consisting of figures 1-7 should be deleted to appear as per attached figures 1-7.

Signed and Sealed this

Eighteenth Day of September, 2007

A handwritten signature in black ink, reading "Jon W. Dudas". The signature is stylized with a large, looped initial "J" and a cursive "Dudas".

JON W. DUDAS
Director of the United States Patent and Trademark Office

(12) **United States Patent**
Martin

(10) Patent No.: **US 6,723,656 B2**
(45) Date of Patent: **Apr. 20, 2004**

- (54) **METHOD AND APPARATUS FOR ETCHING A SEMICONDUCTOR DIE**
- (75) Inventor: Kirk Martin, Apico, CA (US)
- (73) Assignee: Nisene Technology Group, Watsonville, CA (US)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 27 days.
- (21) Appl. No.: 09/902,931
- (22) Filed: Jul. 10, 2001
- (65) Prior Publication Data
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- (51) Int. Cl.⁷ H01L 21/302
- (52) U.S. Cl. 438/745; 438/106; 438/112;
438/124; 438/748; 438/750
- (58) Field of Search 438/106, 112,
438/124, 128, 459, 745, 748, 750, 756

(36) **References Cited**

U.S. PATENT DOCUMENTS

4,359,300 A * 11/1982 Harris et al. 156/345,18
4,372,803 A * 2/1983 Olganik 156/345
5,054,498 A * 11/1991 Miller 438/116
5,252,179 A * 10/1993 Ellerson et al. 216/90
5,956,142 A * 9/1999 Muller et al. 356/357
6,238,936 B1 * 5/2001 Yu 438/7

OTHER PUBLICATIONS

Weavers, Barry A., "Chemical Thinning of Silicon for Emission Microscopy Using Multi ETCH—An Introduction," Nisene Technology Group, Inc., B&G International Division, Aug. 2000, pp. 1-6.
Hypervision, "Hypervision's PTF1 Portable Test Floor Emission Microscope," Hypervision Inc., 2000, pp. 1-8.

Hypervision, "Sensor and Optics Technology: BEAMS and Mercad Telluride (MCT)," Hypervision Inc., 2000, pp. 1-8.
Hypervision, "Chip UnZip Backside Preparation Tool," Hypervision Inc., 2000, pp. 1-4.
Hypervision, "Chip UnZip: Low Stress Backside Semiconductor Preparation," Hypervision, 1998, pp. 1-4.
Adams, Tom, "Backside Emission Microscopy of Wafers," *News and Analysis @Semiconductor Online*, Feb. 28, 2000, pp. 1-3.
Adams, Tom, "Bringing the Emission Microscope to the Test Floor," *News and Analysis @Semiconductor Online*, Jul. 1, 1999, pp. 1-4.
Hypervision, "BEAMS™ (Backside Emission Analysis Microscope System)," Hypervision Inc., 1998, p. 1.
Clark, Scott, MSCE, "Etching Silicon Dioxide with Aqueous HF Solutions," *Silicon Dioxide Etch*, Bold Technologies, Jan. 29, 2001, pp. 1-5.
Bold Technologies, "Manual Equipment", Bold Technologies, Inc., 1998-2000, pp. 1-3.
Nisene Technology Group, "MultiEtch System," Nisene Technology Group, Inc., Jul. 12, 2000, pp. 1-4.

* cited by examiner

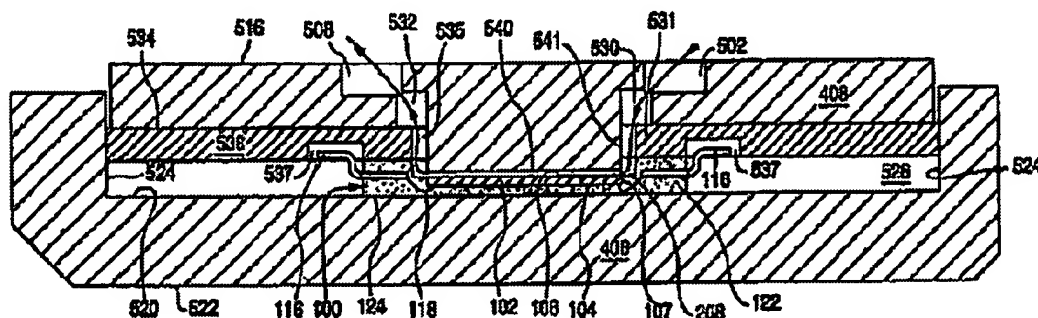
Primary Examiner—Lan Vinh

(74) *Attorney, Agent, or Firm*—Patent Law Group LLP;
Carmen C. Cook

(57) **ABSTRACT**

A method and apparatus for etching a semiconductor die are disclosed whereby flowing an etchant material across an inactive thereof thins the semiconductor die. In one embodiment, the etchant includes a mixture of nitric acid, hydrofluoric acid, and acetic acid and turbulently flows from one edge of the semiconductor die, across the inactive surface of the semiconductor die, to an opposing edge of the semiconductor die.

26 Claims, 7 Drawing Sheets



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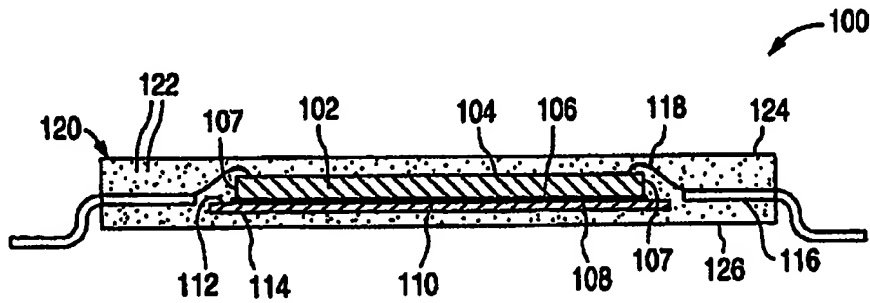


FIG. 1
(Prior Art)

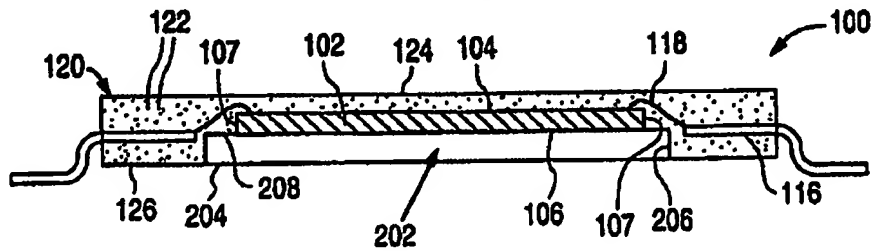


FIG. 2

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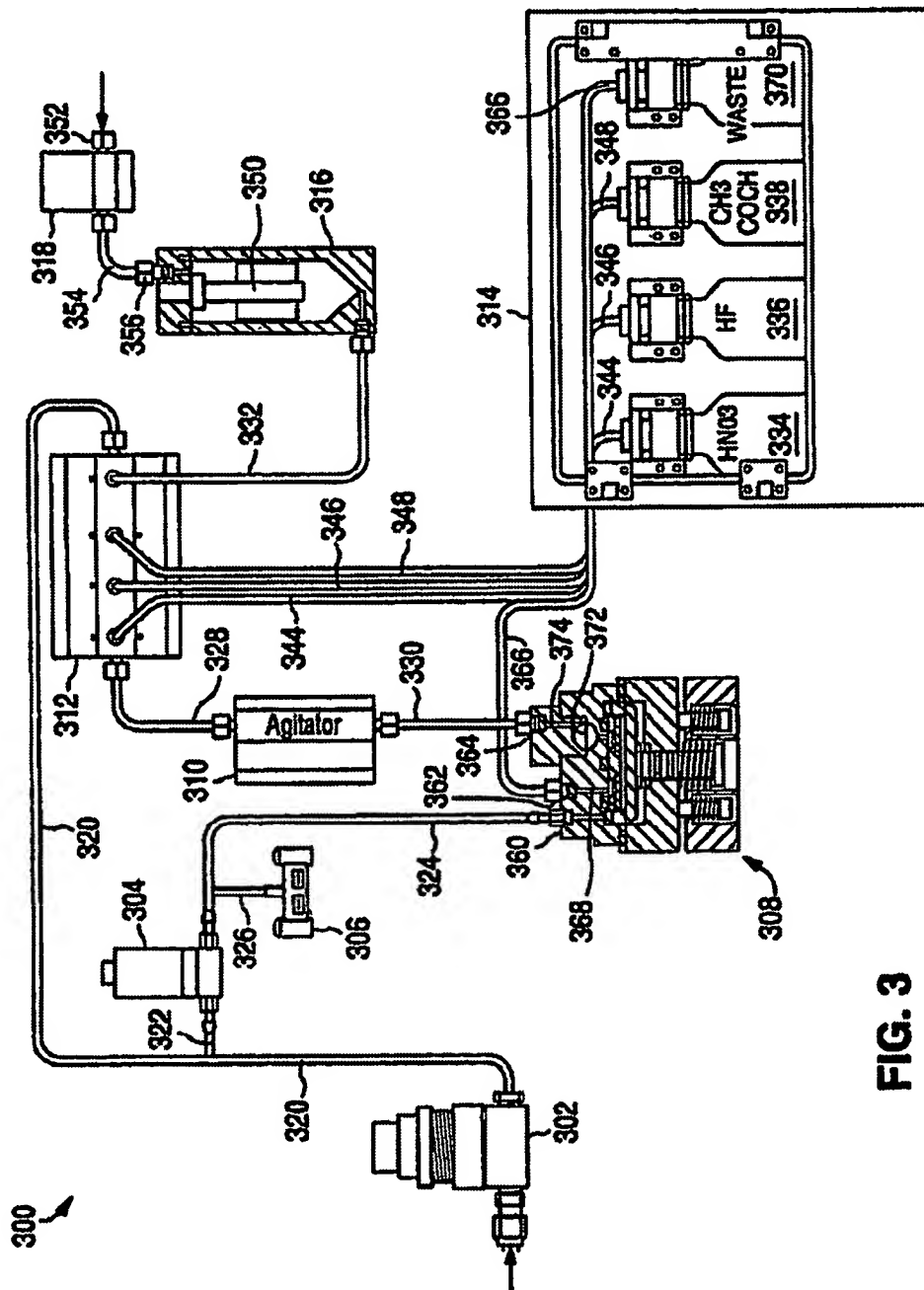


FIG. 3



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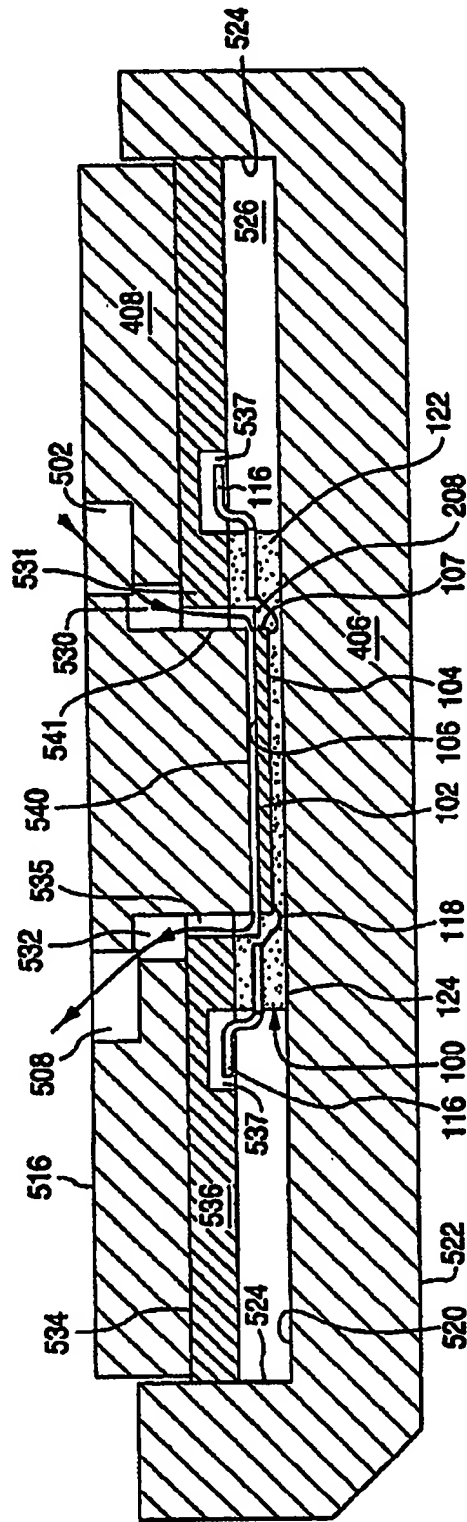


FIG. 5

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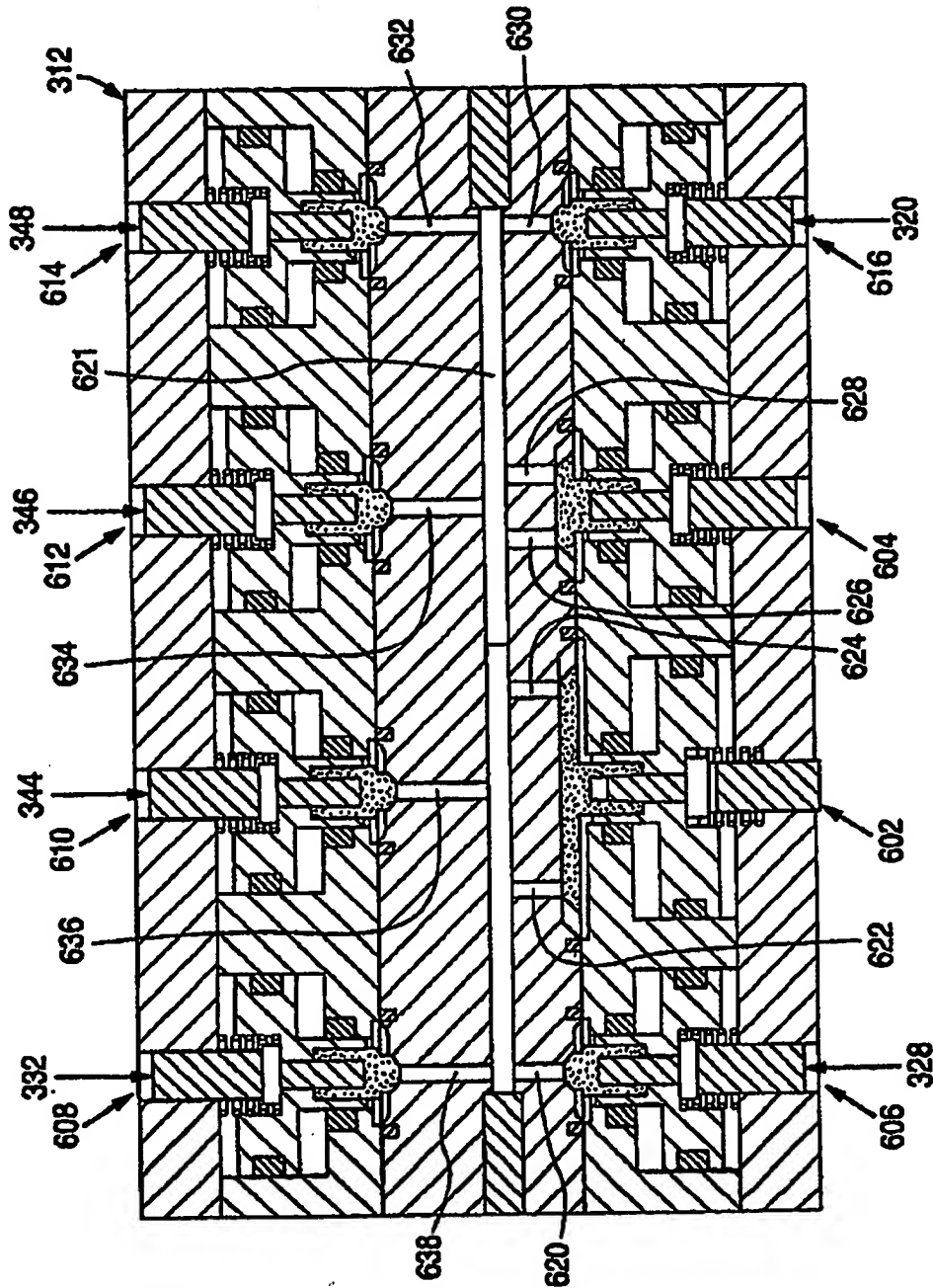


FIG. 6

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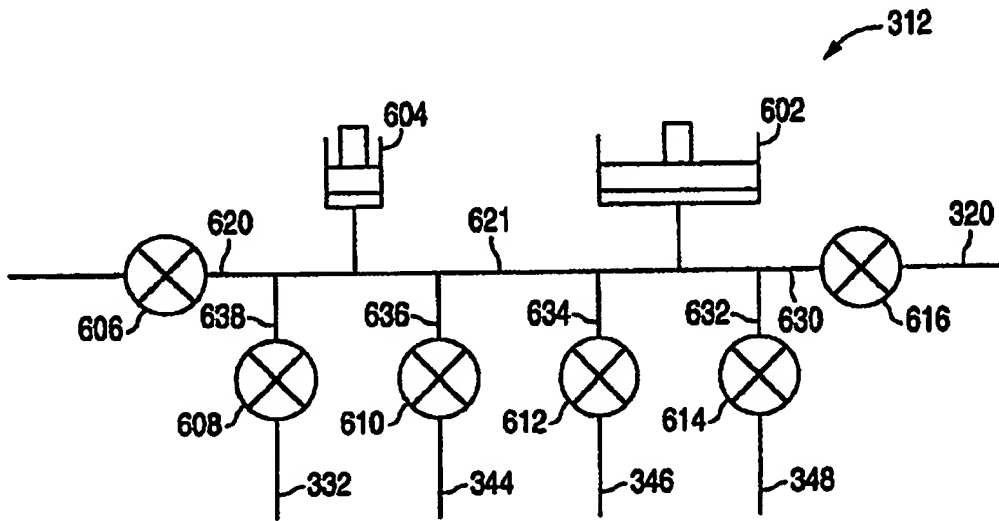


FIG. 7